The results may be thus summarised :—

Station : Aug., 1886.	Inclination.	Force.		Declination.
		Horizontal.	Total.	
St. George, Grenada.....	40° 54′·7	3·1093	4·1144	0° 41′·5 E.
Hog Island, Grenada	41 14·1	3·1000	4·1223	0 51 5 E.
Island of Carriacou.....	—	3·0771	—	0 16 3 E.

II. "Experiments on the Resistance of Electrolytic Cells." By Capt. H. R. SANKEY, R.E. Communicated by W. H. PREECE, F.R.S. Received March 21, 1889.

(Abstract.)

It was observed during the course of some experiments on the electrolytic deposition of copper that the resistance of the electrolytic cells employed was greater the lower the current density, and the experiments described in this paper were undertaken to inquire more definitely into the matter.

Many physicists have already observed the same effect, and have ascribed it to a resistance at the junctions of the electrodes with the electrolyte, and called it "transfer" resistance.

In these experiments a prismatic electrolytic cell of triangular cross-section was employed, and the area of the electrodes was equal to that of the cross-section of the liquid. The electrodes experimented with were electrotype copper, lead, zinc, and platinum, and the electrolytes, solutions of $CuSO_4$ of various sp. gr., neutral and acidulated, of $ZnSO_4$, $MgSO_4$, NaCl, Na_2CO_3, dilute H_2SO_4, &c. The electrodes were placed at different distances apart, but in general had an area of 50 square cm.

All the measurements were made by noting the swing of a Thomson's reflecting galvanometer, used as a potentiometer, and standardised before each trial by means of a Clark's cell.

The current was measured by observing the potential difference across a known resistance.

The P.D. of the cell was proportional to the swing of the spot of light.

The counter E.M.F. was obtained by taking the swing on breaking the circuit, the galvanometer being connected across the terminals of the cell; but this swing is *not* proportional to the C.E.M.F. existing in the cell whilst the circuit is completed. Readings were, there-

fore, taken to obtain the fall of the C.E.M.F. on breaking the circuit, so as to obtain the correction to be applied to the reading. This correction was found to vary considerably according to the electrodes and the electrolytes; with acidulated $CuSO_4$ solutions and electrotype copper electrodes it varied from 3 to 15 per cent.

A variety of tests were made to ascertain what degree of dependence could be placed on these measurements of C.E.M.F., because, of course, on them the whole matter rests. Probably the most conclusive of these tests was the measurement of the resistance (by the method employed in these experiments) of an arrangement, consisting of a box of coils and of an electrolytic cell of very large area, whose resistance might be neglected, but which supplied a C.E.M.F. The measured resistances agreed, within 2 per cent., of the resistance unplugged in the box.

The conclusion come to is that the C.E.M.F. was determined with a fair degree of accuracy, sufficient to show the existence of a transfer resistance.

The resistance of the electrolyte *itself* was measured in some cases by finding the P.D. across two cross-sections of the liquid, by means of fine wires dipping into the liquid at a known distance apart. This resistance was found to be (as might be expected) independent of the current density.

Deducting the resistance of the electrolyte as thus obtained from the resistance of the cell gave the "transfer" resistance.

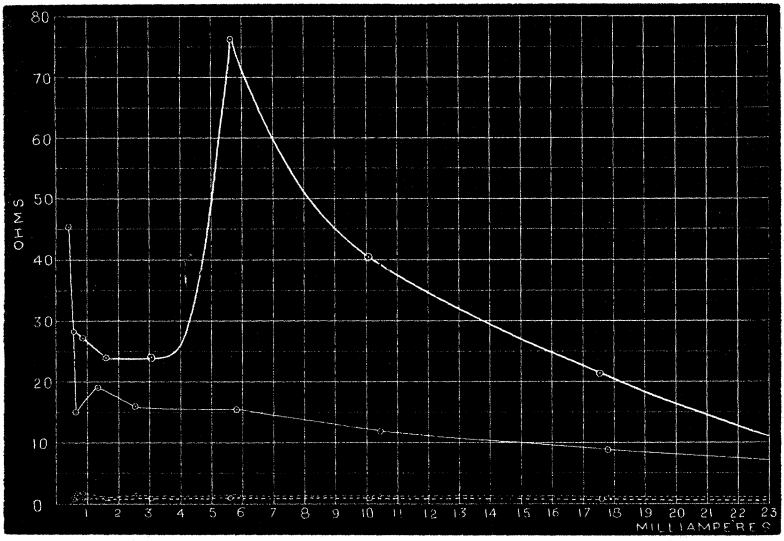
In commencing each trial a current of about 2·7 milliampères was passed through the cell for some time, which was found to increase the resistance of the cell up to a limit depending on the previous history of the electrodes.

The current was then increased by approximately doubling it each time until it reached about 370 milliampères. It was found that as the current increased the resistance diminished, rapidly at first, more slowly afterwards (set A).

After applying the 370 milliampères current, the current was again suddenly reduced to about 2·7 milliampères, and it was found that the resistance had become much smaller, but that it immediately began to increase again, somewhat rapidly at first (set B).

A few minutes afterwards the current was again increased, as in set A, and the resistance was found to diminish as the current increased, but more slowly than in set A (set C). When a current of 370 milliampères was reached, the resistance in both set A and set C were practically equal, and the transfer resistance was small.

The figure shows one of the trials with acidulated $CuSO_4$ solution and lead electrodes. The sudden rise in the resistance (set A) occurred at the moment the cathode became covered with copper. In this figure the thick line shows set A, the thin line set C, and the



dotted lines the resistance of the electrolyte obtained during set A and set C.

A great many trials were made, some few of which are given in the paper. All give evidence of a transfer resistance diminishing as the current increases.

The view is expressed that the "transfer" resistance is *not* due to a non-conducting layer being formed on one or both electrodes, since if such were the case the resistance would increase as the current increases, and would be greater after the application of a strong current than before. It is suggested that this transfer resistance may be due to some molecular interaction at the junction of the electrodes with the electrolyte, offering a greater resistance to weak currents than to strong, and the reduction of the resistance after the application of a strong current supports this suggestion, in that the disturbance set up by the strong currents would probably last for some time.

A trial was made with acidulated $CuSO_4$ solution and electro-copper electrodes under identical conditions, with the exception of the area of the electrodes, which was varied. It was found that the transfer resistance per unit area was sensibly the same for same current density.

The effect of temperature was also inquired into, but only to a limited extent. With weak currents the transfer resistance diminished very rapidly as the temperature increased, and at about 70° C. the transfer resistance was very small.

III. "The Ferment Action of Bacteria." By T. LAUDER BRUNTON, M.D., F.R.S., and A. MACFADYEN, M.A., B.Sc. Received March 23, 1889.

[Publication deferred.]

IV. "On the Limit of Solar and Stellar Light in the Ultra-violet Part of the Spectrum." By WILLIAM HUGGINS, D.C.L., LL.D., F.R.S. Received March 28, 1889.

[Publication deferred.]

Presents, April 4, 1889.

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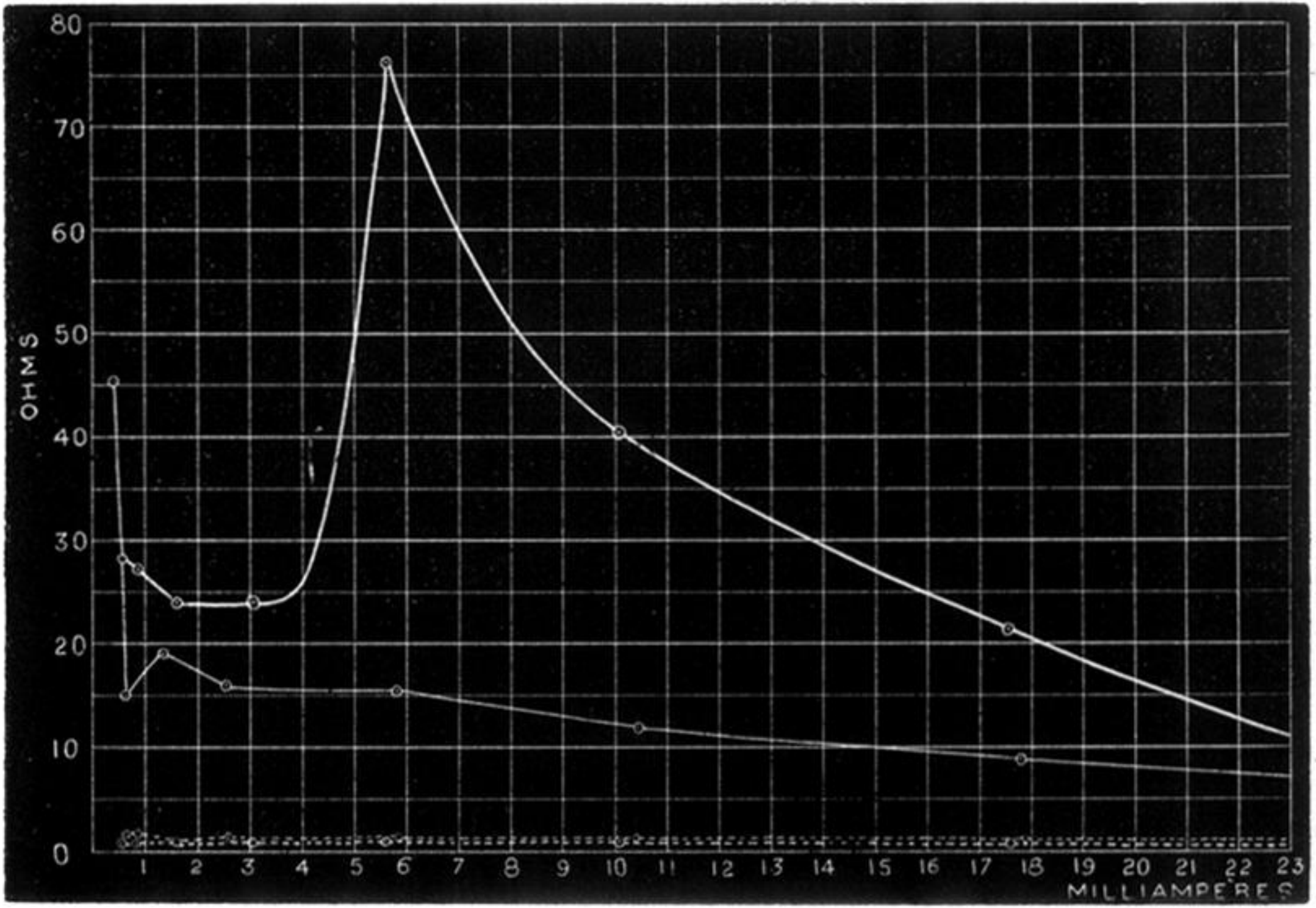
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